

09/424393

430 Rec'd PCT/PTO 24 NOV 1999

LAW OFFICES

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC

2100 PENNSYLVANIA AVENUE, N.W.

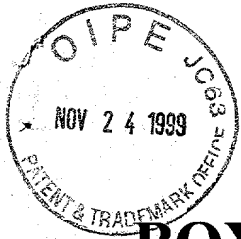
WASHINGTON, DC 20037-3213

TELEPHONE (202) 293-7060

FACSIMILE (202) 293-7860

www.sughrue.com

524 Rec'd PCT/PTO 24 NOV 1999



November 24, 1999

BOX PCT

Assistant Commissioner for Patents
Washington, D.C. 20231

PCT/DK99/00612
-filed November 9, 1999

Re: Application of Jens Mourits SORESEN, Ove Emil HANSEN, and
Martin A.G. SCHOLTEN
A PROCESS FOR PRODUCING A SPRAY DRIED, AGGLOMERATED
POWDER OF BABY FOOD, WHOLE MILK OR SKIM MILK, AND SUCH
POWDER
Our Ref: Q56941

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter I of the Patent Cooperation Treaty:

- ☒ an executed Declaration and Power of Attorney.
- ☒ an English translation of the International Application.
- ☒ one (1) sheet of formal drawings.
- ☐ an English translation of Article 19 claim amendments.
- ☐ an English translation of Article 34 amendments (annexes to the IPR).
- ☒ an executed Assignment and PTO 1595 form.
- ☐ a Form PTO-1449 listing the ISR references, and a complete copy of each reference.
- ☒ a Preliminary Amendment

The Government filing fee is calculated as follows:

| | | | | | | | | | |
|--------------------|---|---|----|---|---|---|---------|---|----------|
| Total claims | 6 | - | 20 | = | 0 | x | \$18.00 | = | \$0.00 |
| Independent claims | 3 | - | 3 | = | 0 | x | \$78.00 | = | \$0.00 |
| Base Fee | | | | | | | | | \$840.00 |

| | |
|----------------------------------|-----------------|
| TOTAL FILING FEE | \$840.00 |
| Recordation of Assignment | \$ 40.00 |
| TOTAL FEE | <u>\$880.00</u> |

09/424393

430 Rec'd PCT/PTO 24 NOV 1999

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC

BOX PCT

Assistant Commissioner for Patents
Washington, D.C. 20231
Page Two
November 24, 1999

PCT/DK99/00612
filed November 9, 1999

Checks for the statutory filing fee of \$840.00 and Assignment recordation fee of \$40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to said Account. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.492 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

There is no claim to priority.

Respectfully submitted,



Neil B. Siegel
Registration No. 25,200

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: November 24, 1999

09/424393

433 Rec'd PCT/PTO 24 NOV 1999

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Jens Mourits SORENSSEN, et al.

Appln. No.: NEW PCT APPLICATION

Group Art Unit: Unassigned

Filed: November 24, 1999

Examiner: Unassigned

For: A PROCESS FOR PRODUCING A SPRAY DRIED, AGGLOMERATED POWDER OF
BABY FOOD, WHOLE MILK OR SKIM MILK, AND SUCH POWDER

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE CLAIMS:

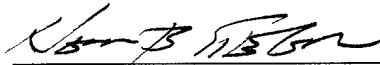
Please amend claim 3 as follows:

Claim 3, line 1, change "claims 1 or 2", to --claim 1--.

REMARKS

The filing of this Preliminary Amendment is to remove the multiple dependency of the
above claim. Therefore, entry and consideration of this Amendment is respectfully requested.

Respectfully submitted,



Neil B. Siegel

Registration No. 25,200

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: November 24, 1999

11/PRJS

09/424393

430 Rec'd PCT/PTO 24 NOV 1999

1

A process for producing a spray dried, agglomerated powder of baby food, whole-milk or skim-milk, and such powder.

5 Field of the invention

The present invention relates to spray drying of milk products, more specifically whole-milk, skim-milk and baby food products of the types termed infant formula and follow-up formula.

10

Background of the invention

Several processes are known for spray drying in which the resulting particles are agglomerated in the very spray drying step or in subsequent steps combined
15 therewith.

The present invention relates to the type of processes in which the liquid concentrates to be spray dried are atomized into a stream of hot drying gas in a spray drying chamber, and the particles formed
20 thereby treated further in a fluidized bed maintained in the bottom portion of the drying chamber. The product recovered from said fluidized bed may be subjected to an after-treatment in a fluidized bed outside the drying chamber.

25 By such a drying system, often termed Multi Stage Drying (MSDTM), much more efficiently agglomerated powders can be obtained than in the prior "straight through" system having no fluidized bed in the drying chamber, i.a. because the existence of the fluidized
30 bed in the bottom of the spray drying chamber permits higher average humidity also in the upper portion of the chamber and the system may be operated to have a substantial amount of fine particles blown off from the fluidized layer and reintroduced in the wet atomizer
35 cloud in the upper part of the chamber (EP 97484,

Niro). Furthermore, a certain agglomeration may take place in the fluidized bed itself and, with proper recycling of fines, in zones near the lower part of the chamber walls (EP 729383, Niro).

5 It is also assumed that in spray drying processes performed in drying chambers having rigid internal gas filters an agglomeration may take place between the particles settling on the filter surfaces (WO 97/14288, Niro).

10 In spite of the several possibilities existing for obtaining an agglomeration in connection with the spray drying process it has hitherto been mandatory to apply a certain re-wetting to obtain a product consisting of the desired large agglomerates. The term "re-wetting"
15 is herein used in a somewhat broader sense than customary within the art of spray drying, and refers to a process in which solid particles are contacted with liquid droplets to create a very sticky surface of the particles hit by the droplets. While the particles are
20 thus temporarily very sticky they adhere together to form large agglomerates which by drying form rather dense granules which only slowly disintegrate when suspended in water.

Re-wetting with a view of increasing the degree of
25 agglomeration may be performed as an after-treatment by spraying water or another liquid onto the powder in an external fluidized after-treatment bed, or it may be performed by introducing fine particle fractions into the drying chamber near the location for atomization of
30 the feed liquid, whereby said particles are hit by the atomized droplets while these are still liquid as it is customary within the art, e.g. in the well-known "straight through" process. Also it is known to use a combination of these two measures as described, inter
35 alia, in EP 0 705 062. Furthermore, it has been sug-

gested to spray water or feed liquid over the internal fluidized layer in the spraying chamber.

However, the use of re-wetting for agglomeration purposes has certain disadvantages.

5 In case the re-wetting is made not with a portion of the feed liquid to be dried but just with water, as it is customary, the process obviously has an increased energy consumption necessary for evaporating the extra water required for the re-wetting.

10 Within the dairy industries it has been recognized that the products of re-wetting processes may be inferior due to bacteriological contamination and also organoleptic qualities may be impaired.

 The present inventors have also experienced that
15 when agglomerates are produced by processes involving re-wetting in the hot atomizer zone, a special product failure becomes important, when baby foods, whole-milk or skim-milk powders to be re-constituted as drinkable liquids for human consumption are produced. Said
20 failure, normally termed "grains", manifests itself as very small lumps of powder visible on the walls of a bottle or glass above the level of a liquid having been agitated to disperse the agglomerated powder therein.

 Although said grains may be of no importance from
25 a nutritional point of view, a large amount of grains may by the consumer be regarded as an indication of inferior product quality, for which reason there is a substantial commercial interest in avoiding or reducing the amount of grains. However, the formation of grains
30 in agglomeration processes recycling fine particles to the atomizer zone is regarded as unavoidable, and may set a maximum limit for the degree of agglomeration used in industrial production.

 A further drawback of the prior art processes
35 involving re-wetting as an after-treatment for obtain-

ing or completing the desired agglomeration is the fact that the operation thereof requires skill and manpower, especially to avoid over-wetting and resulting product deterioration.

5

Summary of the invention

We have now found that it is possible to obtain a high-quality spray dried product of baby food, whole-milk or skim-milk, agglomerated to the desired extent
10 but showing less grains when reconstituted in water than usual for similarly agglomerated, commercial products. Also other product characteristics are improved, resulting in superior organoleptical properties.

15 The above desired qualities are obtained in a single drying apparatus, possibly followed by a conventional after-drying and cooling.

The invention is partly based on the recognition that improved qualities may be obtained by increasing
20 the proportion of agglomeration taking place on and along the inner surface of a part of the conical bottom section of a spray drying chamber, thereby substantially reducing the amount of fine particles being re-wetted by contact with droplets in the atomizer zone in
25 the drying chamber and removing the need for re-wetting the product in the internal or in an external fluidized bed.

Said increase of the proportion of agglomeration taking place on and along the conical bottom section is
30 obtained by collecting fine particles on suitably placed internal filters, being flexible to enable particle release by a short counter blow of a moderate amount of pressurized air.

In the above cited WO 97/14288, Niro, internal
35 filters of rigid materials, e.g. sintered metal, are

disclosed. When fine particles collected on such filters have to be efficiently released, it is necessary to apply a very strong counter blow, meaning that a substantial amount of the fine particles released
5 thereby is spread and dispersed into a large part of the chamber volume. In contrast thereto, particles may be released from the flexible filters by a smaller counter blow at lower pressure which does not spread the particles but allow them to fall directly down on
10 the conical section. The reason for this difference is that when particles have to be released from a rigid filter they are influenced directly of the counter blow air and carried away thereby, whereas each portion of a flexible filter itself receives a short movement or
15 dislocation by the impact of a short counter blow whereby release of particles is effected without spreading thereof.

Thus, the invention deals with a process for producing a spray dried baby food, whole-milk or skim-
20 milk product in which process agglomeration is obtained with less simultaneous increase of the grains rate than usual. The process comprising the following steps:

atomizing a liquid concentrate of baby food, whole-milk or skim-milk as droplets centrally into the
25 upper part of a drying chamber of which at least the lower portion is defined by a downward tapering frusto-conical wall;

introducing drying gas at a temperature of 160-400° C downwards from the top of said chamber around
30 the atomized droplets to partially dry these to moist particles and carry them in a downward widening direction;

maintaining a fluidized particle bed at a temperature of 45-80° C in the bottom of the drying chamber
35 and/or in a lower extension thereof, by means of an

upward stream of fluidizing gas for drying, classifying and agglomeration of the particles therein;

withdrawing a stream of gas comprising spent drying gas introduced at the top of the chamber and gas
 5 from said fluidized bed and at a temperature of 60-95° C from the chamber through flexible filter elements within said chamber, thereby settling fine particles having been entrained by said stream on the surface of the filter elements;

10 releasing the fine particles settled on the flexible filter elements by short, moderate counter blows to cause them to fall down on the frusto-conical wall at a location at level with or above a horizontal ring-shaped area on said wall where the largest concen-
 15 tration of said moist particles would have reached said wall if no fine particles from the filter elements had fallen down thereon, from which location said fine particles slide downwards along the wall as a covering layer to reach said fluidized particle layer;

20 withdrawing an agglomerated product from the fluidized bed fulfilling one of the following three combinations of agglomerate size distribution and grains rate (determined by the method of analysis described herein):

25

(i): D_{10} (< 10%): 50-100 μm , D_{50} (< 50%): 150-225 μm , D_{90} (< 90%): 350-450 μm and grains = 1;

(ii): D_{10} (< 10%): 100-200 μm , D_{50} (< 50%): 225-
 30 400 μm , D_{90} (< 90%): 450-600 μm , and grains above 1 but below or equal to 2;

(iii): D_{10} (< 10%): 200-300 μm , D_{50} (< 50%): 400-
 35 600 μm , D_{90} (< 90%): 600-900 μm , and grains above 2 but below or equal to 3.

The percentages stated in connection with the size distribution limits are by weight.

The above-mentioned grain analysis has been developed by the present inventors and is performed as follows:

Analysis method for grains

30 g of powder are added to 200 ml of 40° C water in a beaker. The mixture is stirred slowly for 20 seconds and then left for 5 minutes. The beaker is then tilted, so that the sides are moistened with solution and again placed in upright position. The amount of white spots left on the sides of the beaker is compared with standard photographs to give a rating from 1 (best) to 6.

The present process enables manufacture of products comprising very large agglomerates without having a higher content of grains than found in presently marketed less agglomerated products. Alternatively, products may be manufactured being only moderately agglomerated but containing extremely few grains.

In the present process the produced particles and agglomerates are subjected to substantially less physical handling than in prior art processes involving external separation of fine particles having been entrained in the spent drying gas and recycling thereof to the chamber. This is also one of the reasons why a superior product is obtained.

The invention also comprises an agglomerated spray dried whole or skim-milk or baby food prepared by the defined process and fulfilling one of the following three combinations of agglomerate size distribution and grains rate:

- (i): D_{10} (< 10%): 50-100 μm , D_{50} (< 50%): 150-225 μm , D_{90} (< 90%): 350-450 μm and grains = 1;
- 5 (ii): D_{10} (< 10%): 100-200 μm , D_{50} (< 50%): 225-400 μm , D_{90} (< 90%): 450-600 μm , and grains: above 1 but below or equal to 2;
- 10 (iii): D_{10} (< 10%): 200-300 μm , D_{50} (< 50%): 400-600 μm , D_{90} (< 90%): 600-900 μm , and grains: above 2 but below or equal 3.

It is believed that a spray dried whole-milk, skim-milk or baby food presenting the combination of agglomeration size distribution and low content of 15 grains specified under (ii) and (iii) above is a novel product, and thus a further feature of the invention is the provision of the products defined in the claims 5 and 6.

The invention is further described with reference 20 to the drawing.

Brief description of the drawing

In the drawing the sole figure very schematically shows a section through a spray drying apparatus with 25 gas, droplets and particle flow indicated to illustrate the process of the invention.

Detailed description of the invention

In the drawing a drying chamber is defined by an 30 upper cylindrical wall 1 and a lower frusto-conical wall 2. Liquid feed in the form of a concentrate of baby food, whole-milk or skim-milk is provided through conduit 3 and by means of an atomizer 4 injected as droplets into the drying chamber.

The atomizer 4 may be of any conventional construction, such as a rotary atomizer wheel, a 2-fluid nozzle or a pressure nozzle. Preferably, it is a pressure nozzle ejecting the atomized droplets in a path forming a hollow wide cone.

For the sake of simplicity, only one atomizer is shown in the drawing. In industrial production a plurality of nozzles will often be used.

Drying gas is provided through conduit 5 and drying gas disperser 6.

In the bottom of the drying chamber a fluidized layer 7 is maintained between the lowest part of the frusto-conical walls 2 and a cylindrical prolongation thereof. Below the fluidized layer 7 is a perforated plate 8 supplied with fluidizing and drying gas through conduit 9 and plenum 10.

In the top of the drying chamber, filter elements 11 are arranged in a circular pattern through which elements spent drying gas introduced through 6 and the vapour formed by the drying are withdrawn to a plenum 12 and exhausted through a duct 13.

The integrated filters have to be fairly flexible filters to secure that fines from the surface of the filters are just released and fall straight downwards when the filter blow-back cleaning is performed. This is not possible using fairly rigid filters as the fines release in all directions due to the higher blow-back pressure needed when the filter walls are not moving, as explained above. Such flexible filters are e.g. fabric filters, bag filters of a woven polymer material possibly supported by an inner metal basket, or non-woven felt filters. Such filter materials may be coated or not.

The materials to be spray dried by the process of the invention are all rather heat-sensitive. It is also

well-known in the art, that when using conventional methods especially the manufacture of highly agglomerated products involves a high risk for product failures such as grains. In spite of this, the process of the invention produces a highly agglomerated product with low grain rates, even when the inlet temperature of the drying gas introduced through 6 is between 160 and 400° C. A high drying gas inlet temperature is essential to achieve a good heat economy in the process, and, thus, the improved product qualities are obtained without increase of energy consumption as in certain prior art processes.

The flow of drying gas from 6 influences the flow path of the droplets ejected from the atomizer 4 as schematically illustrated in the drawing.

(It is to be observed that the drawing has been made without regard to a possible swirling movement imparted by the disperser 6.)

When reaching the area shown hatched in the drawing, the flow of drying gas entraining moist particles formed by drying of the droplets has to turn outwards as schematically indicated. Thereby larger particles, including agglomerates, receive a movement towards the conical chamber walls 2 whereas the drying gas with entrained smaller particles moves upwards to the filter elements 11. This movement is supported by an upward gas stream, also entraining small particles, from the fluidized layer 7. When the gas passes through the filter elements, the entrained particles settle on the surface of the filter elements and form a layer thereon.

Sophisticated systems have been developed for releasing the particles from the surface of filter elements by counter-blowing, also termed back-blowing. Reference is made to co-pending International Patent

Application PCT/DK99/00400 (Niro) describing a system for releasing the particles from the filter elements in a uniform, controlled manner creating an even flow of particles falling down on the conical walls 2 in an annular area which in the drawing is somewhat above the hatched area.

Having reached the conical walls, the particles form a layer sliding downwards in direction of the fluidized layer 7.

10 In contrast to conventional systems in which fine particles are re-introduced into the drying chamber by pneumatical means as described for instance in the above EP 729383, Niro, the particles sliding down the conical walls in the present process are not air-borne
15 and thus form a denser, more compact particle layer with less distance between the individual particles.

When the particle layer sliding down the walls reaches the hatched area they meet the moist particles carried down into said area by the drying gas as
20 explained above, but is not hit by wet droplets to any substantial extent. This means that excellent conditions exist for efficient agglomeration in said area and the high concentration of particles in the sliding layer efficiently protects the chamber walls against
25 deposition of sticky particles.

The partly agglomerated particles then slide further down into the fluidized layer 7 for further drying and agglomeration. In the layer 7 also a certain classification takes place, and fine particles and dust
30 is blown off and agglomerated, some of them after having been separated from the gas by the filter elements 11 and released therefrom to fall down on the chamber wall and pass the hatched agglomeration area.

The products recovered from the layer 7 through
35 exit 14 are usually subjected to an after-treatment,

e.g. drying and cooling in a fluidized bed. If such an after-treatment creates a fraction of too fine particles, these may be re-introduced in the drying chamber for agglomeration as described in the co-
5 pending International Patent Applications PCT/DK99/00511 and PCT/DK99/00512 (both to Niro).

It is essential that the positioning of the flexible filter elements 11 in the drying chamber and the release of fine particles therefrom is performed to
10 ensure a uniform dispersion of the fine particles falling down on the conical wall above the annular horizontal area on the wall, i.e. the hatched area in the drawing, reached by the moist particles from the atomizer.

15 As it appears, the total process is performed without any re-wetting steps, including the conventional contact between fine particles and wet droplets near the atomizer, and this fact is reflected in the superior product qualities as explained above.

20 In the following, the invention is further illustrated by means of non-limiting embodiment examples and a comparison example.

Examples

25 The embodiment examples were performed in an integrated fluid bed dryer as the one shown in the drawing having internal flexible filters blowing back individually for particle release. The comparison example was performed in the same drying chamber but
30 without internal filters. Instead fine particles were collected in a cyclone and recycled. Atomization was in all five examples made by means of a pressure nozzle. The conditions and results are summarized as follows:

| Example | 1 | 2 | 3 | 4 | 5 |
|-------------------------------------|------------------|------------------|------------------|------------------|------------|
| Product | baby food | baby food | whole-milk | whole-milk | whole-milk |
| Feed composition, % w/w: | | | | | |
| Water | 49.8 | 51.9 | 51.3 | 51.3 | 51.3 |
| Protein | 5.9 | 5.6 | 13.4 | 13.4 | 13.4 |
| Fat | 14.1 | 13.5 | 13.0 | 13.0 | 13.0 |
| Carbohydrates | 28.7 | 27.5 | 19.1 | 19.1 | 19.1 |
| Ash | 1.5 | 1.5 | 3.2 | 3.2 | 3.2 |
| Feed, °C | 44 | 44 | 56 | 65 | 63 |
| Feed, kg/h | 38.5 | 35.0 | 34.5 | 39.3 | 38.5 |
| Feed pressure, barg | 27 | 18 | 38 | 18 | 19 |
| Main air inlet, kg/h | 445 | 545 | 550 | 550 | 550 |
| Main air inlet, °C | 194 | 180 | 185 | 180 | 182 |
| Air outlet, °C | 66 | 74 | 76 | 69 | 70 |
| IFB air inlet, kg/h | 251 | 264 | 249 | 227 | 240 |
| IFB air inlet, °C | 59 | 69 | 60 | 86 | 84 |
| Dust separation | internal filters | internal filters | internal filters | internal filters | cyclone |
| Filter air load, m3/h/m2 | 175 | 208 | 186 | 193 | |
| Filter ΔP, mm WG | 37 | 34 | 37 | 36 | |
| Cyclone ΔP, mm WG | | | | | 150 |
| Powder: | | | | | |
| Moisture, % | 3.27 | 2.07 | 2.42 | 3.77 | 3.51 |
| Bulk density not tapped, g/ml | 0.48 | 0.45 | 0.52 | 0.35 | 0.40 |
| Bulk density tapped 100 times, g/ml | 0.54 | 0.50 | 0.65 | 0.41 | 0.49 |
| Free fat, % | | | 0.69 | 0.66 | 1.80 |
| Particle size distribution: | | | | | |
| D ₁₀ (< 10%), μm | 107 | 180 | 65 | 167 | 142 |
| D ₅₀ (< 50%), μm | 285 | 371 | 154 | 464 | 410 |
| D ₉₀ (< 90%), μm | 517 | 619 | 400 | 724 | 702 |
| Grains | 1-2 | 2 | 1 | 2-3 | 5-6 |

As it appears, the tests comprised two examples (1 and 2) drying baby food and three examples (3, 4 and 5) drying whole-milk. The Examples 1-4 illustrate the process of the present invention, using flexible internal filters, whereas Example 5 is a comparison example performed according to prior art using an external cyclone for separating fine particles from the spent drying gas, and reintroducing the particles into the drying chamber near the atomizing nozzle.

The baby food powder produced in Example 1 has a D₅₀ value somewhat higher than what is found for the products presently marketed and at the same time the

rating for grains is at level with the ratings obtained when analyzing the best products in the market.

The baby food powder produced in Example 2 has a D_{50} value much larger than what can be found for 5 products presently marketed. At the same time, the rating for grains is only very little inferior. Normally, such a high D_{50} value is only obtained by conducting fine particles back into the area near the nozzle whereby the amount of grains is increased 10 corresponding to a rating of at least 4.

Examples 3 and 4 both produce whole-milk powder. Example 3 produces a powder less agglomerated than the baby food powder of Example 1, and Example 4 produces a powder even more agglomerated than the coarse baby 15 food powder produced in Example 2. The ratings for grains suited into the pattern for relation of the grains rate to the degree of agglomeration deducible from the Examples 1 and 2. The variation of the agglomeration rates was mainly achieved by operating the 20 nozzle at different pressures.

The comparison Example 5 was performed using the same whole-milk concentrate starting material as in Examples 3 and 4, the internal filters were omitted, and the fine particles entrained in the spent drying 25 gas were separated in an external cyclone and recycled to the nozzle area. The degree of agglomeration was nearly as high as in Example 4 but as far as grains is concerned the product was much inferior.

Further it appears from the table that for the 30 whole-milk powders produced in Examples 3 and 4 an unusually low value for free surface fat was obtained. The values were substantially lower than what was obtained in Comparison Example 5 indicating a more lenient treatment than the one in the Comparison 35 Example.

P A T E N T C L A I M S

1. A process for producing a spray dried baby food, whole-milk or skim-milk product, comprising the following steps:

- 5 atomizing a liquid concentrate of baby food, whole-milk or skim-milk as droplets centrally into the upper part of a drying chamber of which at least the lower portion is defined by a downward tapering frusto-conical wall;
- 10 introducing drying gas at a temperature of 160-400° C downwards from the top of said chamber around the atomized droplets to partially dry these to moist particles and carry them in a downward widening direction;
- 15 maintaining a fluidized particle bed at a temperature of 45-80° C in the bottom of the drying chamber and/or in a lower extension thereof, by means of an upward stream of fluidizing gas for drying, classifying and agglomeration of the particles therein;
- 20 withdrawing a stream of gas comprising spent drying gas introduced at the top of the chamber and gas from said fluidized bed and at a temperature of 60-95° C from the chamber through flexible filter elements within said chamber, thereby settling fine particles
- 25 having been entrained by said stream on the surface of the filter elements;
- releasing the fine particles settled on the flexible filter elements by short, moderate counter blows to cause them to fall down on the frusto-conical
- 30 wall at a location at level with or above a horizontal ring-shaped area on said wall where the largest concentration of said moist particles would have reached said wall if no fine particles from the filter elements had fallen down thereon, from which location said fine

particles slide downwards along the wall as a covering layer to reach said fluidized particle layer;

withdrawing an agglomerated product from the fluidized bed fulfilling one of the following three combinations of agglomerate size distribution and grains rate (determined by the method of analysis described herein):

10 (i): D_{10} (< 10%): 50-100 μm , D_{50} (< 50%): 150-225 μm , D_{90} (< 90%): 350-450 μm and grains = 1;

(ii): D_{10} (< 10%): 100-200 μm , D_{50} (< 50%): 225-400 μm , D_{90} (< 90%): 450-600 μm , and grains: above 1 but below or equal to 2;

15 (iii): D_{10} (< 10%): 200-300 μm , D_{50} (< 50%): 400-600 μm , D_{90} (< 90%): 600-900 μm , and grains: above 2 but below or equal to 3.

20 2. The process of claims 1, wherein the positioning of said flexible filter elements in the drying chamber and the release of fine particles settled thereon is performed to obtain a uniform dispersion of the fine particles falling down on the conical wall
25 above the ring-shaped horizontal area on the wall reached by the moist particles from the atomizer.

3. The process of anyone of the claims 1 and 2, wherein the liquid concentrate is atomized using a pressure nozzle ejecting droplets in a cloud forming a
30 hollow downward widening cone which, influenced by the drying gas, is directed towards the conical wall of the drying chamber.

4. An agglomerated spray dried baby food, whole-milk or skim-milk product produced by the process of
35 claim 1 and fulfilling one of the following three

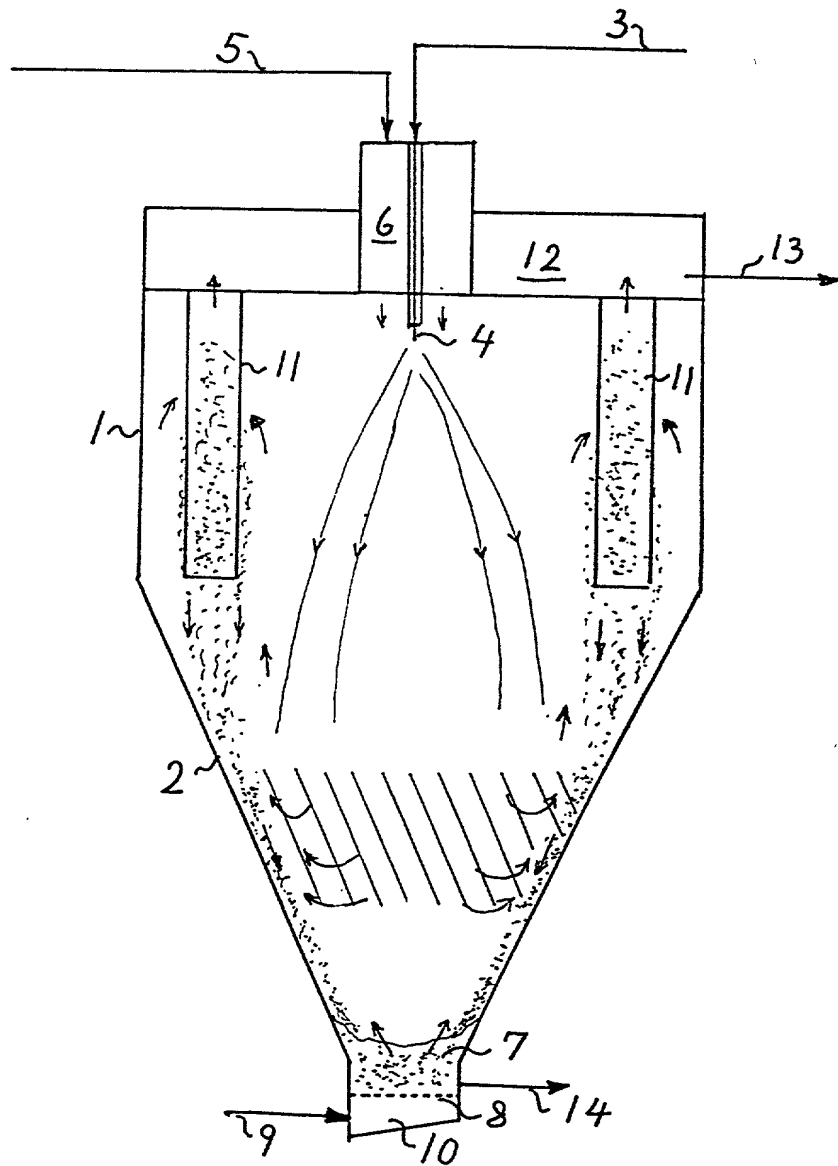
combinations of agglomerate size distribution and content of grains:

- 5 (i): D_{10} (< 10%): 50-100 μm , D_{50} (< 50%): 150-225 μm , D_{90} (< 90%): 350-450 μm and grains = 1;
- 10 (ii): D_{10} (< 10%): 100-200 μm , D_{50} (< 50%): 225-400 μm , D_{90} (< 90%): 450-600 μm , and grains: above 1 but below or equal to 2;
- (iii): D_{10} (< 10%): 200-300 μm , D_{50} (< 50%): 400-600 μm , D_{90} (< 90%): 600-900 μm , and grains: above 2 but below or equal to 3.
- 15 5. An agglomerated spray dried baby food, whole-milk og skim-milk product having an agglomerate size distribution and content of grains: D_{10} (< 10%): 100-200 μm , D_{50} (< 50%): 225-400 μm , D_{90} (< 90%): 450-600 μm , and grains: above 1 but below or equal to 2.
- 20 6. An agglomerated spray dried baby food, whole-milk og skim-milk product having an agglomerate size distribution and content of grains: D_{10} (< 10%): 200-300 μm , D_{50} (< 50%): 400-600 μm , D_{90} (< 90%): 600-900 μm , and grains: above 2 but below or equal to 3.
- 25

A B S T R A C T

Concentrates of baby food, whole-milk and skim-milk are spray dried to produce agglomerated powders having low
5 content of grains as defined herein. High-quality products are obtained by avoiding re-wetting process steps by using flexible internal filters delivering a compact flow of fine particles to the section in the lower portion of the spray dryer where the possibil-
10 ities are optimal for contact with moist particles of suitable moisture content and the risk for contact with wet droplets and hot drying air is small.

15 (Fig. 1)



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name: that I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural names are listed below) of the subject matter claimed and for which a patent is sought in the application entitled:

"A PROCESS FOR PRODUCING A SPRAY DRIED, AGGLOMERATED POWDER OF BABY FOOD, WHOLE MILK OR SKIM MILK, AND SUCH POWDER"

which application is:

☐ the attached application
(for original application)

☒ application Serial No. _____, and amended on _____

(for declaration not accompanying application)

that I have reviewed and understand the contents of the specification of the above-identified application, including the claims, as amended by any amendment referred to above; that I acknowledge my duty to disclose information of which I am aware and which is material to the examination of this application under 37 C.F.R. 1.56; and that I hereby claim foreign priority benefits under Title 35, United States Code §119, §172 or §365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified on said list any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed:

| Application Number | Country | Filing Date | Priority Claimed (yes or no) |
|--------------------|---------|-------------|---------------------------------|
|--------------------|---------|-------------|---------------------------------|

I hereby claim the benefit of Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in a listed prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge my duty to disclose any material information under 37 C.F.R. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| Application Serial No. | Filing Date | Status (patented, pending, abandoned) |
|------------------------|-------------|------------------------------------------|
|------------------------|-------------|------------------------------------------|

I hereby appoint John H. Mion, Reg. No. 18,879; Donald E. Zinn, Reg. No. 19,046; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; Peter D. Olexy, Reg. No. 24,513; J. Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Robert G. McMorrow, Reg. No. 19,093; Louis Gubinsky, Reg. No. 24,835; Neil B. Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; Joseph J. Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. 29,710; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; Susan J. Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Scott M. Daniels, Reg. No. 32,562; and Brian W. Hannon, Reg. No. 32,778, my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to SUGHRUE, MION, ZINN, MACPEAK & SEAS, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date Nov 4-99 First Inventor Jens Mourits SØRENSEN
Residence VIRUM, Denmark Signature J. Mourits
Post Office Address 7 Skovridergårdsvej, DK-2830 VIRUM
Citizenship Danish Denmark

Date Oct. 23-99 Second Inventor Ove Emil HANSEN
Residence SØBORG, Denmark Signature Ove Emil Hansen
Post Office Address 22 Ravnsholtvej, DK-2860 SØBORG, 3450 ALLERØD
Citizenship Danish Denmark

320
Date October 29, 1999

Residence RUNGSTED KYST, Denmark

Citizenship Denmark

Third Inventor Martin Andreas Grønlund SCHOLTEN

First Name Middle Initial Last Name

Signature *M. Grønlund*

Post Office Address 6 Christiansgave, DK-2960

RUNGSTED KYST, Denmark

Date _____

Residence _____

Citizenship _____

Fourth Inventor _____

First Name Middle Initial Last Name

Signature _____

Post Office Address _____

Date _____

Residence _____

Citizenship _____

Fifth Inventor _____

First Name Middle Initial Last Name

Signature _____

Post Office Address _____

Date _____

Residence _____

Citizenship _____

Sixth Inventor _____

First Name Middle Initial Last Name

Signature _____

Post Office Address _____

Date _____

Residence _____

Citizenship _____

Seventh Inventor _____

First Name Middle Initial Last Name

Signature _____

Post Office Address _____